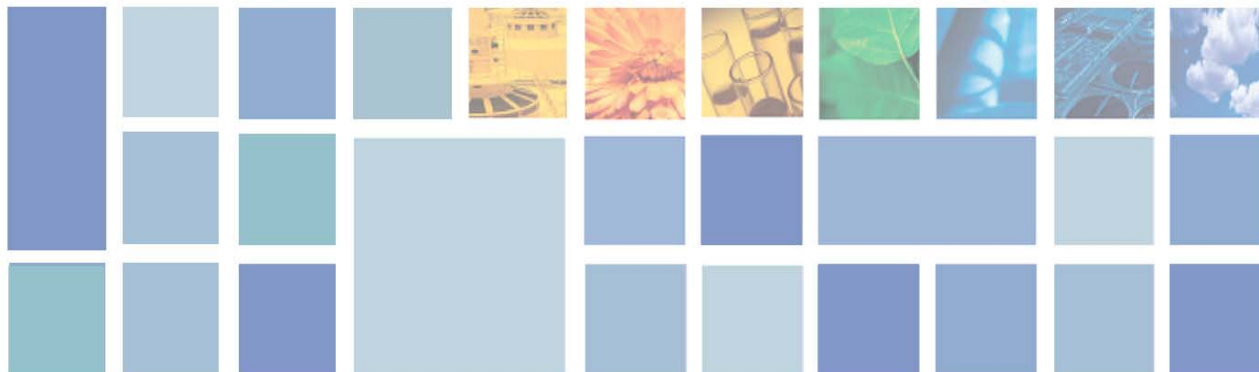


As Removal from Drinking Water Adsorption Media Handling

EPA Workshop on Adsorptive Media Processes

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Severn Trent Water Purification, Inc.
August 11, 2004



Discussion Topics



- 💧 Media Characteristics
- 💧 Packaged Media Delivery & Handling
- 💧 Adsorber Loading
- 💧 Residuals Handling
- 💧 Media Conditioning & Backwashing
- 💧 Media Regeneration
- 💧 Spent Media Removal
- 💧 Media Disposal

Adsorptive Media Characteristics

💧 Bulk Density & Specific Gravity

- Higher Lb/Ft³ = Greater Unit Weight & Higher Fluidization Flows

💧 Shape & Size

- Granules, Pellets, Spherical Beads, Powder
- Normal Adsorptive Media Size
 - Low ΔP but Lower Unit Capacity
- Finer Adsorptive Media Size
 - Higher Unit Capacity but High ΔP

💧 Flowability & Friability

- Ease of Loading & Removal
- Physical Attrition in Handling or Service

💧 Miscellaneous

- NSF Certification, Consistency, Availability, etc.

Sieve Sizes & Tyler Equivalents

Std Sieve Designation	Sieve Opening		Wire Dia mm.	Tyler Mesh Size
	mm.	inches		
8.00 mm	8.00	0.312	2.07	2.5
6.73 mm	6.73	0.265	1.87	3
5.66 mm	5.66	0.223	1.68	3.5
4.76 mm	4.76	0.187	1.54	4
4.00 mm	4.00	0.157	1.37	5
3.36 mm	3.36	0.132	1.23	6
2.83 mm	2.83	0.111	1.10	7
2.38 mm	2.38	0.0937	1.00	8
2.00 mm	2.00	0.0787	0.900	9
1.68 mm	1.68	0.0661	0.810	10
1.41 mm	1.41	0.0555	0.725	12
1.19 mm	1.19	0.0469	0.650	14
1.00 mm	1.00	0.0394	0.580	16
841 μ m	0.841	0.0331	0.510	20
707 μ m	0.707	0.0278	0.450	24
595 μ m	0.595	0.0234	0.390	28
500 μ m	0.500	0.0197	0.340	32
420 μ m	0.420	0.0165	0.290	35
354 μ m	0.354	0.0139	0.247	42
297 μ m	0.297	0.0117	0.215	48
250 μ m	0.250	0.0098	0.180	60
210 μ m	0.210	0.0083	0.152	65
177 μ m	0.177	0.0070	0.131	80
149 μ m	0.149	0.0059	0.110	100
125 μ m	0.125	0.0049	0.091	115
105 μ m	0.105	0.0041	0.076	150
88 μ m	0.088	0.0035	0.064	170
74 μ m	0.074	0.0029	0.053	200
63 μ m	0.063	0.0025	0.044	250
53 μ m	0.053	0.0021	0.037	270
44 μ m	0.044	0.0017	0.030	325
37 μ m	0.037	0.0015	0.025	400

SORB 33™ - Bayoxide® E33 Media

💧 Granular Iron Media – “GIM”

- Manufactured for STS by Bayer AG
- α -Ferric Oxide Hydroxide or α -FeOOH
- Granular Ferric Oxide (GFO) - Crystalline

💧 Physical Properties

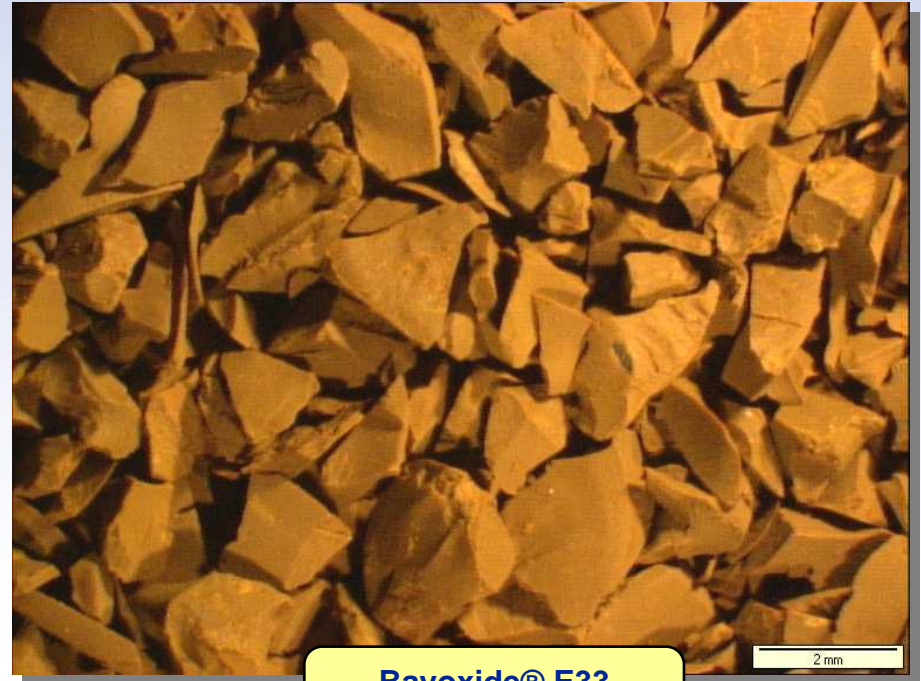
- Appearance – Yellow/Orange
- Particle Size Distribution – 0.5-2.0 mm
- Bulk Density – 29 Lb/Ft³
- Specific Gravity – 3.6 g/cc
- Flowability – Flows like GAC when flooded
- Friable Relative to GAC & AA

💧 Packaging

- 38 Ft³ Supersacks
- 2 or 4 Ft³ Drums

💧 Similar Commercial Product

- US Filter's GFH – Granular Ferric Hydroxide
- Manufactured by Wasserchemie - GEH



Bayoxide® E33
Granular Ferric Oxide

Media Storage & Delivery



💧 Some Medias are Dry; Some are Moist

💧 Media Shelf Life

- Life Time from Production (4-30 Months)
- Storage Requirements – Conditioned or Ambient
- Product Deterioration – Drying, Surface Loss, etc.
- Inventory – Responsibility by Supplier or Utility

💧 Delivery

- Drums, Supersacks or Bulk
- Larger Unit Volume Minimizes Handling
- Vessel Accessibility for Media Fills

Adsorber Media Loading

💧 Solids Handling - Rules of Thumb

- Dry Solids Gravity Feed - Simplest
 - Minimal Wastewater & Dust
- Slurries Hydraulic Feed
 - Next Easiest
 - Wastewater Generation – Reuse Capability
- Moist Solids from Packaging
 - Labor Intensive with Product Losses

💧 Fill Equipment Requirements

- Readily Available Equipment
- Specialized - Availability

💧 Regional Media Service

- Size, Experience & Specific Know-how



EPA Demo Project
Anthony, NM
SORB 33™ 300 GPM Unit

Adsorber Loading – STW Process

💧 Severn Trent Water (STW)

- 2nd Largest Utility in the UK
- 46 MGD of Capacity
- 60 Vessels @ 16 Sites

💧 “Central” Bulk Handling System

- Fill Bulk Carbon Tanker from Sacks Off Site
- Transport Dewatered Media Next Day
- Pictured Site – Sugarbrook
 - 4 12'-Ø Adsorbers in Parallel
 - 3.6 MGD Total Capacity



STW – Sugarbrook Plant
Bayoxide® E33 Media Fill



Adsorber Loading – STW Process

💧 “Central” Bulk Handling System (Cont’d)

- Hydraulic Fill of Empty Adsorber from Tanker
- Partial Media Conditioning during Fill
- Wastewater Routed to Backwash Water Reclaim

💧 Process Assessment

- Works Well for STW
- Labor Intensive & Multiple Media Handling



STW – Sugarbrook Plant
Bayoxide® E33 Media Fill

Adsorber Media Loading

💧 Dry Solids Loading

- Headroom Access for Sacks or Drums
 - Crane, Boom Truck or Forklift Access
- Pneumatic Transfer
 - Equipment Intensive – Dust Collection
 - Media Attrition

💧 Slurry Loading

- Hopper/Eductor Equipment
- Wastewater Handling

💧 Regional Media Service

- Size, Experience
- Specific Know-how

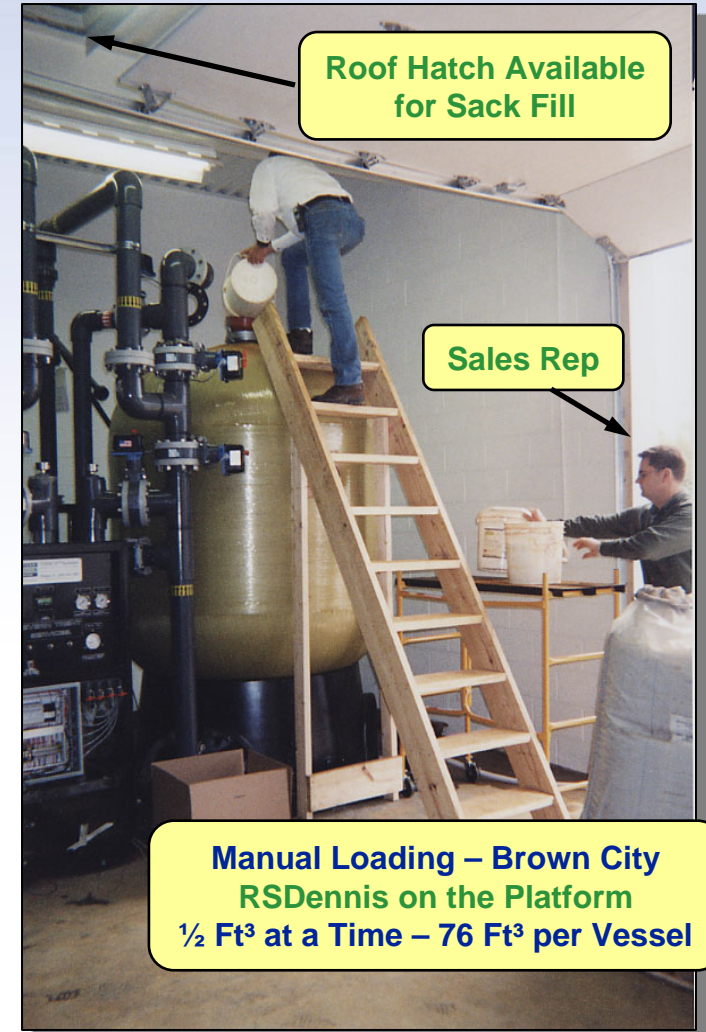


Hopper & Eductor Loading
Nottingham, UK

Media Loading – Dry Gravity Fill



- Small Systems - <300 Ft³ Inventory
- Roof Hatch Included/Added for Dry Fill
- Boom Truck Access w/4"-Ø Flex Hose
- Both Sites – 300 GPM APU Systems



Media Conditioning & Backwashing



💧 Pretreatment Requirements for Service

- Media Wetting
- Conditioning for Fines Removal – Bed Fluidization
- Regeneration & Rinsing if Media “Conversion” Required
- Off-line Time Requirements - Backwashing

💧 Residuals Handling - Wastewater

- Volume Generated & Quality – Toxicity, Solids & Corrosivity
 - Classification & Permits
- Non-hazardous Liquids – Ditch, Sewer, Evaporation Pond, POTW
- Solids-bearing Liquids – Decant Tank to Settle & Collect Solids
- Zero Discharge – Surge Tank to Reclaim Liquid to As System Inlet

Media Regeneration & Spent Waste



💧 Need for Media Regeneration

- Medias with Low As Capacities - <10,000 Bed Volumes (BV's)
- Co-adsorption of PPM Level Contaminants – Fluoride, etc.

Spent Media Removal

💧 Adsorber Vessel Underdrain Type

- Header/Lateral or HUB & Spoke
- Cone Bottom with Screened Nozzles
- False Bottom with Screened Nozzles or Porous Plate
- Distribution Gravel Underbedding

💧 Media Removal Method

- Pressurized Hydraulic Slurry Flow
- Vacuuming
- Gravel Underbedding Removal
- Hydraulic Wastewater Disposal



Spent Media Removal

💧 Considerations

- Available Off-line Timing for Change-out
- Vessel Entry Needs – Disinfection, etc.
- Simple, Complete Removal vs Thorough Process
- Gravel Underbedding Losses/Replacement
- Empty Vessel Internals Inspection

💧 Severn Trent Water Process

- Underdrain: Header/Lateral with Gravel
- Drain Vessel & Media Bed of Water
- Vacuum Media from Top Manway to Truck
- Leave Gravel Underbedding Intact
- Vessel Entry: Remove Media “Heal” & Inspection
- Labor Intensive – UK Safety Laws



Spent Media Disposal

💧 Spent Media Classification

- Hazard Criteria for Leachate: As > 5 mg/L; V > 5 mg/L; Cr > 5 mg/L
- Non-Hazardous Classification – Passes EPA's TCLP Solids Waste Test
 - TCLP – Toxic Characteristic Leaching Procedure
- Hazardous Waste Solids – 3-6 Times More Expensive Disposal
- Total Mass of As Not Critical to Hazard Classification

💧 California Hazard Classification

- Soluble Threshold Limit Concentration (STLC) – the “WET” Test
 - More rigorous test than TCLP
- Total Threshold Limit Concentration (TTLC)
 - Total Mass of As in the Solid – Limit is 500 mg/Kg As
 - Some Medias Have As Capacity Greater than this TTLC Limit